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Science and Art Gossip.

REMARKABLE mirages are frequently observed in the southern and central parts of Sweden, and a specially noteworthy one was seen recently over the Lake of Orsa. A number of large and small steamers were reflected as if plying on the lake, and the smoke could even be seen rising from their funnels. Later on, the scene changed to a landscape, the vessels now taking the form of islands in the lake, covered with more or less vegetation, and at last the mirage dissolved itself in a haze. The phenomenon, which lasted from four to seven o'clock p.m., is said to have furnished a most magnificent spectacle.

SOME speculative merchants in Bergen have obtained the right of cutting block-ice for export from the enormous glacier, Fon or Svartisen (69° 25′ north, 35° 15′ east, on the Senjen Island, in Norway, the northernmost of its kind in Europe. The quality of the ice is good. The glacier is about 120 square miles in extent, and the distance from its border to the sea is only a couple of miles. A similar attempt to utilise the glacier Folgefonden was made some years ago, but failed, owing to the blocks in their downward course breaking through the wooden conductor in which they were slid down to the sea.

PROFESSOR CHRISTIAN exhibited at a recent meeting of the Physical Society of Berlin, a new method of preservation by which organic bodies are coated galvanoplastically. A mulberry-leaf, a crab, a butterfly, a beetle, the brain of a rabbit, a rosebud, and other objects were plated with silver, gold, or copper, and showed all details of their outer form, down to the finest shadings. The objects to be preserved are first put into a solution of silver nitrate in alcohol, then dried and treated with sulphuretted and phosphuretted hydrogen, when they form good conductors, which, brought in the usual way into the galvanoplastic bath, can be coated with any desired thickness of a metallic deposit.

ONE of the hardest woods in existence is that of the desert ironwood tree, which grows in the dry wastes along the line of the Southern Pacific Railroad. Its specific gravity is nearly the same as that of lignum-vitæ, and it has a black heart so hard, when well seasoned, that it will turn the edge of an axe, and can scarcely be cut by a well-tempered saw. In burning it gives out an intense heat.

A SULPHUR mine in Sicily was recently set on fire in a very curious manner. A waggon loaded with sulphur was being drawn up an incline, when the rope supporting it broke, and the waggon rushed back into the mine at a frightful speed. The rapid motion developed heat enough to set on fire the highly combustible ore, and the flames spread so quickly through the mine that thirteen workmen were unable to escape, and thirty or forty others were seriously injured.

A REMARKABLE sand-storm, accompanied by an intensely cold temperature, raged in Iceland for two weeks during the spring. The air was so filled with dry fine sand that it was impossible to see for more than a short distance, and the sun was rarely visible, though the sky was clear of clouds. Nobody ventured out of his house except upon matters of most urgent necessity, and many who were exposed to the storm were frozen. The sand penetrated into the houses through the minutest crevices. It was found mixed with articles of food and drink, and every breath drew it into the lungs. Thousands of sheep and horses died.

DR. SCHWEINFURTH has succeeded in freshening and preserving many of the leaves and flowers from garlands found on the breasts of mummies discovered last year at Deir el Bahari. A small herbarium is thus formed from plants which grew thirty-five centuries ago. A number of the species have been identified with those now found in the East.

THE call for an electrical sheep-shearer made by a New Zealand correspondent in *The Scientific American* some months ago, has apparently brought forth fruit in an unexpected quarter. It is now announced that the head of the Hudson Bay Fur Company, Sir Curtis Lampson, has applied electricity to the trimming of sealskins. The skin is "fed" over a knife-edge bar, above which is stretched a fine platinum wire, which, raised to a white heat by an electric current, meets the longer hairs which rise above the under fur, and mows or burns them down.

AT a recent meeting of the Paris Académie a paper was read on a use of electrolysis in dyeing and printing, by M. Goppelsrœder. For example, he impregnates tissues or paper with an aqueous solution of chlorhydrate of aniline, puts it on a non-attackable metal plate, which he connects with one pole of a battery or small dynamo. On the tissue or paper is placed a second metal plate having a design in relief and joined to the other pole; on pressure and passage of the current the design is reproduced. A modification of the method gives chemical discharge of colour. The current, again, is used to prepare vats of indigo, aniline black, &c.; the hydrogen which arises at the negative pole being utilised. It is also used to prevent oxidation of colours in printing.

THROUGH an excess of current accidentally brought about, the wires for conducting the electricity for illuminating the stage of the Paris Opera lately became red-hot, burnt their covering of gutta-percha, and caused a fire, which, however, was speedily extinguished with a few buckets of water. Such events as these are of the class that result from what must be culpable carelessness.

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The longest span of wire in the world is used for a telegraph in India, over the river Kistnah, between Bezorah and Sectanagrum. It is more than 6,000 feet long, and is stretched between two hills each 1,200 feet high.

We are informed that the British Electric Light Company have recognised the fact of their infringement of the Edison patents for electric lighting by paying a substantial sum as royalty to the Edison Electric Light Company (Limited).

We are given to understand that "the School of Telegraphy and Electrical Engineering," which has been carrying on its work at 4, George-street, Hanover-square, under the less elegant title of "the School of Submarine and Military Telegraphy, Telephony, Electric Light, and Technical Instruction Company," has removed to 12, Princes-street, Hanover-square, and that the school reopens after the summer vacation, on Sept. 1.

Asbestos Paint.—A public demonstration of the United Asbestos Company's fire-proof paint, as a preventive of fire, took place recently on a piece of vacant ground in Whitehall-place, adjoining the Thames Embankment. The demonstration had been arranged with special reference to the inquiries now being made respecting the fire-proof qualities of this paint. For the purpose of testing these, two wooden buildings, constructed in the form of theatres, one of them coated with ordinary paint and the other with asbestos paint, were filled with shavings and fired at the same moment, and, in the course of a few minutes, the first named was a mass of blazing ruins, while the only sign of injury shown by the asbestos paint was that it had been blistered with the heat. A second experiment was then made for the purpose of showing the efficacy of a draught-proof curtain, in the event of a fire breaking out upon the stage, in preventing the spread of flames. The experiments were generally regarded as satisfactory in favour of the asbestos paint.

THE BRITISH ASSOCIATION.

By the Editor.

THE tone in which the meetings of the British Association are almost always spoken of by the press, weekly as well as daily, is one of such unmixed gratulation that we hesitate to express what, nevertheless, is our carefully formed opinion to a contrary effect. We see and hear it stated on all sides that these annual visits of the Association to important centres of the population stir up throughout the country an enthusiasm for science which otherwise would not have existed; and the Association itself gravely claims as its own work that growth of scientific zeal which certainly has continued during a large portion of the existence of the British Association. In his opening address this year, Dr. Siemens even implied that "those special societies which have sprung into existence since the foundation of the British Association" (the Physical, Geographical, Meteorological, Linnæan, &c., &c.,) owe their existence in reality to its influence. Nay, the very development of scientific journalism which began before the founding of the Association, and has done its work in creating and fostering it, is spoken of by Dr. Siemens as part of the work of a body whose meetings occupy but a small portion of each year, and whose work seems to those who contemplate it from the outside, with some apprehension of the real wants of unscientific people, to be quite incapable of producing the effects thus in all good faith attributed to it.

When we come to analyse the actual proceedings of the British Association, at any of its meetings, we cannot but recognise the fact that these holiday gatherings of science can scarcely develope in any useful way (except by the sort of scientific tax levied on the towns visited) the advancement of science. Putting on one side the work of the various sections in as far as it is done by men of science for men of science—which amounts, indeed, chiefly to the kind of work known as "mutual admiration"—what particular effect is likely to be produced on the general public by what comes before them at these gatherings?

At most of them, you will be told, the presidential address is altogether the most interesting part of the affair: at others, addresses on subjects of special interest may invite and attract attention; but nearly always there is a great falling-off in attention and attendance after the presidential address. Now the address of the President is nearly always a recapitulation of successes achieved up to the time of the meeting, and chiefly during the preceding year. It may be an able literary work, covering skilfully the whole ground of science, like Sir John Lubbock's address last year at York; it may be a brilliant lecture, such as Professors Tyndall or Huxley have delivered, with so much that is striking—in both senses of the word—that the hearers really are interested (but not more than they would be in a special lecture given by skilful speakers, as are Tyndall and Huxley); or it may be a recapitulation wanting both in oratorical and literary skill, yet still a fair general account of what has been done in the past year; or, lastly, it may be a recapitulation by a specialist of such work only as has been done in his special department. But, in any and every case, in what way can a recapitulation of scientific progress possibly interest either the scientific or the unscientific? The scientific know all about it; the unscientific cannot possibly care at all about it, presented in a crude and condensed form (as it must be in a recapitulation). Such interest as a Lubbock may excite by literary ability in an address, or a Tyndall or a Huxley by lecturing skill, is in reality outside the task specially to be performed in these addresses.

Thus, during Dr. Siemens' address—to take a concrete example, a fair average sample of these things—the audience could be readily classified by an observer of any keenness, into two portions—those who were wearied because they knew already all that the speaker told them, and those who were wearied because they could make nothing of such statements as were flung at their heads, as, for instance, that "a Watt expresses the rate of an Ampère multiplied by a Volt, while a horse-power is 746 Watts, and a Cheval de Vapeur 735." To use the charmingly simple mode of illustration which Dr. Siemens beamingly bestowed on his audience, as something sweet and poetical which they would like to remember, unscientific minds must not be crossed at a sharp angle by scientific statements, but "looked upon as the asymptotes to be approached indefinitely by the hyperbolic course" of scientific exposition.

I am not sure but that the most encouraging feature of the presidential address was the effect produced in the "place of skulls" on the platform. If the scientific part of the audience had been interested, the unscientific might have despaired indeed; "*if this* is what interests men of science," they might have thought, "how *can* men of science have anything to say which would interest us." But when one bald pate after another was bowed in sleep, and of the others on the platform scarce a tenth tried to hide the

effects of a "twice" (or twenty times) "told tale," the rest of the audience might have gathered comfort from the thought that science *must* have something better in store than this dried food. As a matter of fact many of the audience seemed to have no such consoling hope, and during the last half of the address, the cries of the coachmen were heard by a much larger section of the audience than the voice of the president. It is not difficult to understand why, during the rest of the Association week, *soirées* and excursions attract more than sectional meetings and evening discourses. We venture to express our strong conviction that for months if not years to come, the interest taken by Southampton in science will be considerably less than it has been during the past few years.

The President's Address.

It will be understood that thus viewing the mere recapitulation of well-known facts, we do not propose to trouble our readers with a full report of an address, nine-tenths of which related to matters long since sufficiently dealt with in these columns. We give in full only those portions of the address which we think likely to prove of interest. The words of one who has done much to advance science must always be worth hearing when he is dealing with his own subject, or expressing his own views; and even in an address intended to be a recapitulation, a man of original thought cannot at times avoid his own subjects or the expression of original ideas.

After touching on the deaths of Charles Darwin in the fulness of years, and of Professor Balfour, when his work was but fairly entered upon (reference to the more recent loss of Professor Stanley Jevons might not ungracefully have been added), Dr. Siemens referred to the past and future of the British Association—to the past as encouraging, to the future as full of promise. He then spoke of the harmony which should exist between theory and practice in science. "The advancement of the last fifty years," he said, "has, I venture to submit, rendered theory and practice so interdependent that an intimate union between them is a matter of absolute necessity for our future progress. Take, for instance, the art of dyeing, and we find that the discovery of new colouring matters derived from waste products, such as coal-tar, completely changes its practice, and renders an intimate knowledge of the science of chemistry a matter of absolute necessity to the practitioner. In telegraphy and in the new arts of applying electricity to lighting, to the transmission of power, and to metallurgical operations, problems arise at every turn, requiring for their solution not only an intimate acquaintance with, but a positive advance upon, electrical science, as established by purely theoretical research in the laboratory. In general engineering the mere practical art of constructing a machine so designed and proportioned as to produce mechanically the desired effect would suffice no longer. Our increased knowledge of the nature of the mutual relations between the different forms of energy makes us see clearly what are the theoretical limits of effect; these, although beyond our absolute reach, may be looked upon as the asymptotes to be approached indefinitely by the hyperbolic course of practical progress, of which we should never lose sight. Cases arise, moreover, where the introduction of new materials of construction, or the call for new effects, renders former rules wholly insufficient. In all these cases practical knowledge has to go hand in hand with advanced science in order to accomplish the desired end. Far be it from me to think lightly of the ardent students of nature, who, in their devotion to research, do not allow their minds to travel into the regions of utilitarianism and of self-interest. These, the high priests of science, command our utmost admiration; but it is not to them that we can look for our current progress in practical science, much less can we look for it to the 'rule of thumb' practitioner, who is guided by what comes nearer to instinct than to reason. It is to the man of science who also gives attention to practical questions, and to the practitioner who devotes part of his time to the prosecution of strictly scientific investigations, that we owe the rapid progress of the present day, both merging more and more into one class, that of pioneers into the domain of nature."

He soon after adverted to the diversity of usage in this country and the Continent as respects weights and measures:—"As regards the measures of length and weight, it is to be regretted that this country still stands aloof from the movement initiated in France towards the close of last century; but, considering that in scientific work metrical measure is now almost universally adopted, and that its use has been already legalised in this country, I venture to hope that its universal adoption for commercial purposes will soon follow as a matter of course. The practical advantages of such a measure to the trade of this country would, I am convinced, be very great, for English goods, such as machinery or metal rolled to current sections, are now almost excluded from the Continental market, owing to the unit measure employed in their production. The principal impediment to the adoption of the mètre consists in the strange anomaly that, although it is legal to use that measure in commerce, and although a copy of the standard mètre is kept in the Standards Department of the Board of Trade, it is impossible to procure legalised rods representing it, and to use a non-legalised copy of a standard in commerce is deemed fraudulent."

Dr. Siemens spoke next at considerable length on the subject of electrical measurement—suggesting the use of two further units—a unit of magnetic quantity to be called a "Weber" (Clausius's suggestion), and a unit of magnetic power to be called a "Watt." His remarks on electrical energy, on telegraphy, the telephone, and the electric railway, contained nothing which would be new to our readers, or which will not presently be dealt with in a more readily understood manner in these columns. In addition to what has already appeared in Knowledge respecting Dr. Siemens' experiments on the influence of the electric light upon vegetation, the following may be added as of interest, "In experimenting upon wheat, barley, oats, and other cereals sown in the open air, there was a marked difference between the growth of the plants influenced and those uninfluenced by the electric light. This was not very apparent till towards the end of February, when, with the first appearance of mild weather, the plants under the influence of an electric lamp of 4,000 candle power placed about five mètres above the surface, developed with extreme rapidity, so that by the end of May they stood above 4 ft. high, with the ears in full bloom, when those not under its influence were under 2 ft. in height, and showed no sign of the ear."

Dr. Siemens next referred to electric railways, remarking that while they possess great advantages over horse or steam power for towns; in tunnels, and in all cases where natural sources of energy, such as waterfalls, are available, it would not be reasonable to suppose that they will (in their present condition) compete with steam propulsion upon ordinary railways. What followed on the definition of metals from their solutions, on electric lighting, and on secondary batteries, would not be new to readers of Knowledge. Speaking of by-products in gasworks—a subject on which Mr. Mattieu Williams has already written

in these pages—Dr. Siemens made the following remarkable statements :—

"The total annual value of the gasworks by-products may be estimated as follows :—Colouring matter, £3,350,000; sulphate of ammonia, £1,947,000; pitch (325,000 tons), £365,000; creosote (25,000,000 gallons), £208,000; crude carbolic acid (1,000,000 gallons), £100,000; gas coke, 4,000,000 tons (after allowing 2,000,000 tons consumption in working the retorts), at 12s., £2,400,000—total, £8,370,000. Taking the coal used, 9,000,000 tons, at 12s., equal £5,400,000, it follows that the by-products exceed in value the coal used by very nearly £3,000,000. In using raw coal for heating purposes these valuable products are not only absolutely lost to us, but in their stead we are favoured with those semi-gaseous by-products in the atmosphere too well known to the denizens of London and other large towns as smoke. Professor Roberts has calculated that the soot in the pall hanging over London on a winter's day amounts to fifty tons, and that the carbonic oxide, a poisonous compound, resulting from the imperfect combustion of coal, may be taken as at least five times that amount. Mr. Aitken has shown, moreover, in an interesting paper communicated to the Royal Society of Edinburgh last year, that the fine dust resulting from the imperfect combustion of coal is mainly instrumental in the formation of fog, each particle of solid matter attracting to itself aqueous vapour; these globules of fog are rendered particularly tenacious and disagreeable by the presence of tar vapour, another result of imperfect combustion of raw fuel, which might be turned to much better account at the dye-works. The hurtful influence of smoke upon public health, the great personal discomfort to which it gives rise, and the vast expense it indirectly causes through the destruction of our monuments, pictures, furniture, and apparel are now being recognised, as is evinced by the success of recent Smoke Abatement Exhibitions. The most effectual remedy would result from a general recognition of the fact that wherever smoke is produced fuel is being consumed wastefully, and that all our calorific effects, from the largest down to the domestic fire, can be realised as completely, and more economically, without allowing any of the fuel employed to reach the atmosphere unburnt. This most desirable result may be effected by the use of gas for all heating purposes with or without the addition of coke or anthracite."

We must not pass over references to the probable future improvement of our merchant steam shipping by the use of more perfect engines (gas-engines, of half the weight of the present, and working with only half the present expenditure of fuel) of the new kind of steel (mild steel) introduced by the Admiralty in 1876-78, by which 20 per cent. of the weight of a ship's hull can be saved, of double bottoms, and solid bulkheads for the division of a ship's hold. "With such improvements," said Dr. Siemens, "the balance of advantages in favour of steam vessels (or, rather, propeller vessels) would be sufficient to restrict the use of sailing craft chiefly to the regattas of Southampton and neighbouring ports."

After speaking of deep-sea soundings, and recent improvements therein, Dr. Siemens referred to the proposed means for crossing the Isthmus of Panama, and the suggested flooding of the Tunis Algerian desert. He spoke of the new Eddystone Lighthouse, and the St. Gothard tunnel, the proposed tunnel below the English Channel, and England's impressive "military anxieties" respecting it. After touching on other sub-pontine works, suggested or in progress, Dr. Siemens spoke of the improvement of explosive agents, cannon, &c.

His remarks on the phenomena of electric discharges were of considerable interest. "By the discharge of high-tension electricity through tubes containing highly-rarefied gases (Geissler's tubes), phenomena of discharge were produced which were at once most striking and suggestive. The Sprengel pump afforded a means of pushing the exhaustion to limits which had formerly been scarcely reached by the imagination. At each step the condition of attenuated matter revealed varying properties when acted upon by electrical discharge and magnetic force. The radiometer of Crookes imported a new feature into these inquiries, which at the present time occupy the attention of leading physicists in all countries. The means usually employed to produce electrical discharge in vacuum tubes was Ruhmkorff's coil; but Mr. Gassiot first succeeded in obtaining the phenomena by means of a galvanic battery of 3,000 Leclanché cells. Dr. De La Rue, in conjunction with his friend Dr. Hugo Müller, has gone far beyond his predecessors in the production of batteries of high potential. At his lecture 'On the Phenomena of Electric Discharge,' delivered at the Royal Institution in January, 1881, he employed a battery of his invention consisting of 14,400 cells (14,832 volts), which gave a current of 0·054 ampère, and produced a discharge at a distance of 0·71 inch between the terminals. During last year he increased the number of cells to 15,000 (15,450 volts), and increased the current to 0·4 ampère, or eight times that of the battery he used at the Royal Institution. On the occasion of his lecture, Mr. De La Rue produced, in a very large vacuum tube, an imitation of the aurora borealis; and he has deduced from his experiments that the greatest brilliancy of aurora displays must be at an altitude of from thirty-seven to thirty-eight miles—a conclusion of the highest interest, and in opposition to the extravagant estimate of 281 miles at which it had been previously put."

It was hardly to be expected that the eminent electrician should not make an attempt to galvanise into the semblance of life his defunct theory of the conservatism of solar energy. In some way peculiar to the inventors of impossible theories, he finds evidence for his speculations where others recognise decisive (though in this case little needed) evidence against it. The long extensions of the corona not far from the equatorial regions, seen during the American eclipse of 1878, if constantly visible, would correspond with the theory. But if the theory were true, they should be always visible. During the Egyptian eclipse last May they were absent; but "No matter," Dr. Siemens thinks; "the outflowing equatorial streams I suppose to exist could only be rendered visible by reflected sunlight, when mixed with dust produced by exceptional solar disturbances, or by electric discharge; and the occasional appearance of such luminous extensions would serve only to disprove the hypothesis entertained by some that they are divided planetary matter, in which case their appearance should be permanent"—it being, he might as soundly have added, a well-known property of planetary matter to remain permanently at rest.* "Stellar space filled with such matter as hydrocarbon and aqueous vapour would establish a material continuity between the sun and his planets, and between

* The argument is this: If there were the constant streaming forth from the equator imagined by Dr. Siemens, the equatorial streams should always be there. If there is cosmical dust travelling round and about the sun in orbits of all degrees of eccentricity, not only would eclipses seen in different months differ much *inter se*—but owing to the constant motion of the cosmic matter, so also would eclipses seen in different years in the same month. Dr. Siemens thinks just the reverse—doubtless having some reasons. Unfortunately he omits to mention them.

the innumerable solar systems of which the universe is composed." We are not told what would be the extreme tenuity of such matter necessary that even the nearest sun should show his light through twenty millions of millions of miles of it, or of what possible benefit the action of rays on matter midway between our own sun and the nearest sun (*i.e.* matter ten billions of miles from either) could possibly be to the systems circulating either around our own sun or around Alpha Centauri (and the like for other stellar neighbours not quite so near). Still,—No matter. In a vague sort of way, we may be able—at least Dr. Siemens says we may—"to trace certain conditions of thermal dependance and maintenance, in which we may recognise principles of high perfection, applicable also to comparatively humble purposes of human life. So then" (though the *sequitur* may not be very obvious to all, the idea itself is worthy of all praise), "we fellow-workers in every branch of science my exhort one another in the words of the American bard who has so lately departed from among us:—

> Let us then be up and doing,
> With a heart for any fate;
> Still achieving, still pursuing,
> Learn to labour and to wait.

Mathematical Section.

From the address by Lord Rayleigh, president of this section, we extract the following well-considered remarks:—"In one important part of the field of experimental science, where the subject-matter is ill understood, and the work is qualitative rather than quantitative, success depends more directly upon sagacity and genius. It must be admitted that much labour spent in this kind of work is ill directed. Bulky records of crude and uninterpreted observations are not science, nor even in many cases the raw material out of which science will be constructed. The door of experiment stands always open; and when the question is ripe, and the man is found, he will, nine times out of ten, find it necessary to go through the work again. Observations made by the way, and under unfavourable conditions, may often give rise to valuable suggestions, but these must be tested by experiment in which the conditions are simplified to the utmost, before they can lay claim to acceptance. When an unexpected effect is observed, the question will arise whether or not an explanation can be found upon admitted principles. Sometimes the answer can be quickly given, but more often it will happen that an assertion of what ought to have been expected can only be made as the result of an elaborate discussion of the circumstances of the case, and this discussion must generally be mathematical in its spirit, if not in its form. This is shown by the investigations of the well-known experiment of the inaudibility of a bell rung in vacuo. Leslie made the interesting observation that the presence of hydrogen was inimical to the production of sound. Years afterwards Stokes proved that what Leslie observed was exactly what ought to have been expected. The addition of hydrogen to attenuated air increases the wave-length of vibrations of given pitch. Examples such as this, which might be multiplied *ad libitum*, show how difficult it often is for an experimenter rightly to interpret his results without the aid of mathematics. The experimenter himself should be in a position to make the calculations to which his work gives occasion. I should like to see a course of mathematical instruction arranged with especial reference to physics, within which those whose bent was plainly towards experiment might, more or less completely, confine themselves. Probably a year spent judiciously on such a course would do more to qualify the student for actual work than two or three years of the usual mathematical curriculum. On the other side, it must be remembered that the human mind is limited, and that few can carry the weight of a complete mathematical armament without some repression of their energies in other directions. The different habits of mind of the two schools of physicists sometimes lead them to the adoption of antagonistic views on doubtful and difficult questions. The tendency of the purely experimental school is to rely almost exclusively upon direct evidence. The tendency of the mathematician is to overrate the solidity of his theoretical structures, and to forget the narrowness of the experimental foundation upon which many of them rest."

Chemical Section.

In the course of his address to this section by Professor Liveing, the following interesting remarks were made on two matters which have recently been the subject of controversy, now regarded, however, as disposed of. "When we find that the combinations of particles of the same kind are as definite as those of particles of different kinds, and that they are both subject to precisely the same mechanical laws, we are hardly justified in regarding the forces by which they are produced as essentially different. To get rid of a gratuitous hypothesis in chemistry must be a great gain. But, it may be asked, why stop here? Why may not the chemical elements be further broken up by still higher temperatures? *A priori*, and from analogy, such a supposition is extremely probable. The notion that there is but one elementary kind of matter is at least as old as Thales, and underlies Prout's hypothesis that the atomic weights of our elements are all multiples of that of hydrogen. This famous hypothesis has gone up and down in the scale of credibility many times during the present century. Quite recently," said the speaker, "a fresh revision of the combining weights has been made on the other side of the Atlantic by Professor F. W. Clarke, who, on the whole, concluded that Prout's hypothesis, as modified by Dumas, is still an open question—that is to say, his final numbers differ from whole multiples of a common unit by quantities which lie within the limits of errors of observation and experiment. Let us turn again to the evidence afforded by our most powerful instrument for inspecting the inner constitution of matter, the spectroscope. A few years ago Mr. Lockyer supposed that the coincidence of rays emitted by different chemical elements, particularly when those rays were developed in the spark of a powerful induction coil and in the high temperatures of the sun and stars, gave evidence of a common element in the composition of the metals, which produced the coincident rays. Later results cannot fail to shake our belief in the existence of any common constituent of the chemical elements; but it does not touch the evidence which the spectroscope affords us that many of our elements, in the state in which we know them, must have a very complex molecular structure. The spectroscope has in the last few years revealed to us several new metals. Why may there not be elements which, while they differ as little in atomic weight as do nickel and cobalt, are, on the other hand, so similar to one another in all characters that their chemical separation is a matter of the greatest difficulty, and their difference only distinguishable by the spectroscope? The spectra may be thought to suggest so much, and how shall we decide the question? At any rate, the complications of the spectroscopic problem can only be unravelled by the united efforts of chemists and physicists, and by the exercise of extreme caution." Prof. Liveing said he could not dismiss the subject of chemical

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dynamics without alluding to the ingenious theory by which the President of the Association has proposed to account for the conservation of solar energy. Commenting on this, he remarked that, "if it be true that the compounds are decomposed by absorbing the sun's rays, we ought to find in our atmosphere the products of decomposition; we ought to find it in free hydrogen, carbonic oxide, and acetylene, or some other hydrocarbons. The hydrogen, from its small specific gravity, would not be concentrated in the lower regions of our atmosphere in the same proportions as the denser gases, but carbonic oxide and hydrocarbons could not fail to be detected in the air if they formed any sensible proportion of the gases in interplanetary space."* Dewar and he had recently shown that if nitrogen already in combination—as, for instance, ammonia—be brought into a hydrocarbon flame, cyanogen is produced in sufficient amount to give in a photograph (though not so as to be directly visible) the characteristic spectrum of cyanogen as it appears in the comet. It is therefore, he said, "no longer necessary to make any other supposition to account for the cyanogen bands in the spectra of comets, than that ammonia, or some such compound of nitrogen, is present as well as hydrocarbons in a state of ignition." Quite recently Dr. Huggins has observed that the principal comet of this year has a spectrum of an entirely different character, but he is not yet able to say to what elements or compounds it is probably due. The notion that comets may bring us news of distant parts of stellar space, towards which our system is driving, where the atmosphere is not like ours—oxygen and nitrogen—but hydrogen and hydrocarbons, may fascinate the fancy, but the laws of occlusion oblige us to think that the meteorites have not merely wandered through an attenuated atmosphere of hydrogen and hydrocarbons, but have cooled in a much denser atmosphere of those substances, which we can only conceive as concentrated by the presence of a star or some large aggregation of matter. No comet on visiting our system a second time can repeat the exclusion of its occluded gases unless its store has been replenished in the interval; and it will be interesting to see, when Halley's comet next returns, whether it shines only by a reflected light or gives us, like so many others, the banded spectrum of hydrocarbons.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

VII.—THE TWIN CITIES, PA-TUM AND PA-RAMESES.

HAVING endeavoured to show how the foregoing monumental and Bible dates are capable of being brought into concordance, and how the chronological problem (which some have pronounced to be insoluble) ceases to be formidable when carefully tabulated, I now propose to examine, not the chronological, but the historical evidence which connects Rameses II. with the period of the oppression.

M. de Rougé's identification, it will be remembered,† is founded in the first place on the name of the city which was built by the forced labour of the Hebrew settlers; and, in the second place, on the length of the reign of Rameses II.

Now, if it were possible to identify the site of this city (Raamses), or, better still, the sites of both the "treasure-cities" specified in the Bible, and if it could also be shown beyond reasonable doubt that they were indeed built by Rameses II., then the correspondence between Hebrew and Egyptian evidence would amount to positive proof.

The Hebrew evidence is brief and precise:—"And they built for Pharaoh treasure-cities, Pithom and Raamses." (Exodus i., 11.)

That is to say, they built a treasure-city (in Egyptian, a *Bekhen*) called Pa-Tum, or Pi-Tum, and a treasure-city called Pa-Rameses, or Pi-Rameses; the one signifying the "*Pa*," or abode, of Tum, and the other the "*Pa*," or abode, of Rameses. Tum was a solar Deity chiefly worshipped in the East of Delta, where lay the land of Goshen. Rameses is a royal and divine name, meaning the Son of Ra. It was borne as a proper name by two Pharaohs of the XIXth Dynasty, and also by a long succession of Pharaohs of the XXth Dynasty; but in the hands of Rameses II. of unbounded arrogance, it became something more than a mere affiliation of the King to the Sun-god Ra. It became the name of a living and personal God, Rameses Mer-Amen, Pharaoh and deity, self-elected in the flesh to the circle of the Gods. In this sense, Pa-Rameses, no less than Pa-Tum, was a city dedicated to a deity; and we may be certain that Pa-Tum and Pa-Rameses each contained a temple in honour of the tutelary God of the place. Nor is the juxtaposition of these two names, Pa-Tum and Pa-Rameses, altogether fortuitous. The God Ra and the God Tum were closely related in the system of Egyptian solar myths; the one representing the diurnal, and the other the nocturnal, sun. Or, in other words, Ra was the risen sun, the giver of life and light, while Tum was the setting sun, precursor of the shades of night. They were even said (as M. Grébaut has shown in his celebrated translation of a "Hymn to Amen-Ra") to engender each other—day giving birth to night, and night becoming in turn the parent of day. And it is in this sense, as symbolising life, death, and resurrection, that we frequently find Ra and Tum represented together on funereal tablets.

Pa-Rameses and Pa-Tum were therefore twin cities, sanctified by the twin temples (the "Abodes" of Tum and Rameses) after which they were named; the cult of the one temple being the complement of the cult of the other. Hence it is reasonable to conclude that Pa-Rameses and Pa-Tum were situate not very far apart.

The question next arises—where *were* they situate? To this it may be answered that they were undoubtedly situate in the land of Goshen; that same land which, in the XLVIIth chap. of Genesis is called indifferently both Goshen and Rameses. That it should be called "Rameses" thus early in the sacred narrative is in itself a very significant fact. It shows that at the time when the Mosaic books were compiled—or, in modern phrase, edited—this province was no longer exclusively called by the name of its ancient capital, Gessen, or Goshen, but was also familiarly known by the name of the Pharaoh who ordained the building of the treasure-cities. It also shows that it is in this district of Goshen, or Rameses, that we must look for the site of that *Bekhen* called "Raamses," which is the object of our present inquiry.

There has been a great diversity of opinion among Egyptologists as to the site of this famous *Bekhen*, the difficulty of identifying which is considerably increased by the fact that it was the supreme will and pleasure of Rameses II. to give his name, not only to every new city of his own creation, but even to cities built long before his time and already famous in history. Thus at Aboo

* The calm way in which Professor Liveing crushes, under chemical considerations, the theory already killed by physical and mathematical reasoning is worth observing.

† See Knowledge, No. 35, Vol. II., p. 2.

Simbel, to the town which sprang up in connection with the great rock-cut temples of Ra and Hathor, this Pharaoh gave the name of Pa-Rameses. To a town—or perhaps a new out-lying suburb—south of Memphis, he gave the name of Pa-Rameses. To at least three towns in the Delta, he gave the name of Pa-Rameses. And Brugsch-Bey some years since discovered a hieroglyphic text which shows that he even imposed the name of Pa-Rameses upon the ancient and magnificent city of Zoan. Basing his opinion upon this text, Brugsch maintains that Zoan (in Egyptain, Tān; in Greek, Tanis; in modern Arabic, Sān) and the "Raamses" of the Bible are one and the same. M. Chabas proposes Pelusium, a lonely mound in the midst of a waste of marshes by the sea-shore, about twenty miles due east of Port Said. Others have suggested Heliopolis (On), Babloon (old Cairo), and Toossoom, on the Suez Canal. Lepsius and Ebers, both of whom have personally inspected the locality, give their verdict in favour of a mound locally known as Tel-el-Masroota, or Maskhuta, better known to travellers in Egypt as the station called "Ramsis," which is the last station but one on the line between Cairo and Ismailiah.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT—II.

FOLLOWING upon what was said in the preceding article, electromotive force may be defined as "a difference of electrical potential, in virtue of which electricity is transferred from one place to another." If, then, we connect two bodies of equal potential, there being no difference between their potentials, there will be no electromotive force, and consequently no current. If we were to connect two boilers with steam at a high pressure, by means of a pipe, no movement or reduction of pressure could take place. The pressure is there, nevertheless, and were either of the boilers but partially exhausted, the energy laid up in the other would develope an equilibriating flow which would continue until the unequal pressure no longer existed. In the battery cell a difference of potential is maintained by the series of chemical changes which help to upset the equilibrium as quickly as it is established. This action is well described by Tyndall, who says, "An incessant effort, never fully satisfied, is made to establish electric equilibrium; the incessant renewal of the effort maintains the electric current." In dynamo-electric machines a difference of potential is maintained by the rotation of the armature. Returning to our connected boilers, it should be apparent to all that the pressure in both will be the same, whatever may be their relative capacities; that is to say, if one is twice the size of the other, the pressure in the smaller one will be exactly the same as in the large one, but the amount or weight of steam varies in proportion to the capacities.

The same principle is seen in electricity. The intensity, or, more correctly speaking, the electro-motive force, of a battery is solely dependent upon the sum of the differences of potential, and is quite independent of the size, weight, or shape of the plates. A little reflection will make clear the fact that the force or intensity of the action, say, of sulphuric acid on a single atom of zinc, is identical with that exerted upon a million atoms. Discard for a moment, if you like, the electrical side of the question, and regard only the affinity existing between the metal zinc and the acidulated water, and the same conclusion will enforce itself. The easiest way, perhaps, of making this point clear is by analogy. Let us liken the action to a battle between equally numerous armies, in which every combatant fights his hardest, and supposing the men on each side to be all of the same strength, and filled with exactly the same desires towards their opponents, it is clear that the struggle will be as strong between any two opposing men as it will be between the whole of the two contending armies. The numerical equality assumed in this simile is warrantable, because however much water we may use, a single atom of zinc can enter into union with but one atom of oxygen (one of the two constituents of water). What, then, is the advantage of increasing the size of our plate? If there is nothing gained by so doing, a pin's point of zinc opposed to a pin's point of copper should give us the highest attainable intensity. The advantage gained is somewhat similar to that which would result from increasing the size or capacity of our boiler. We generate more electricity, a greater amount or quantity of it, a current capable of doing more work of certain kinds. We shall see more clearly what this means when we take into consideration the applications of Ohm's law.

The electro-motive force imparted to a current by any particular source of electricity is a matter of great importance, and becomes a factor requiring careful and accurate measurement. The unit of E.M.F. (electro-motive force) is called a *volt*, in honour of Volta, one of the pioneers of electric Science.

A committee, appointed in Paris last year, is now occupied in settling the method of determining the value of a volt; but even were this task accomplished, the term involves so many complex calculations, that before we could give a satisfactory definition, we should have to monopolise two or three whole numbers of KNOWLEDGE. Approximately, the volt is equal to a Daniell cell in good condition. Consequently, this battery is generally used as a standard of E.M.F.

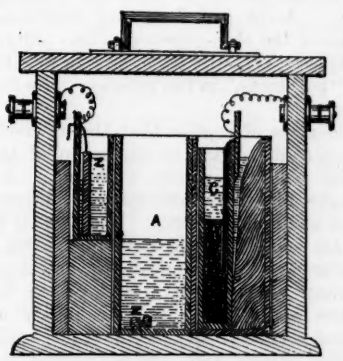


Fig. 1.

Fig. 1 represents the form of standard cell used in the Postal Telegraph Service. It is easily constructed, very reliable, constant, and altogether may be fairly regarded as the best form. In a wooden trough or case are three chambers. The left hand one contains water, in which a zinc plate (Z) is suspended. The right-hand chamber contains the flat, porous pot, immersed in water. A copper plate (C) and sulphate of copper crystals are placed in the porous pot. The centre chamber (A) is about half-filled with a semi-saturated solution of sulphate of zinc, in which the zinc plate and porous pot are immersed when the battery is in use. A small rod of zinc (z) is placed in a small compartment at the bottom of the chamber, its function being to displace any copper which may get into the zinc solution, thereby keeping that solution clear, and

so maintaining the constancy of the cell. The two side chambers are called "idle" cells, as the zinc plate and porous pot are placed in them when the cell is not working. The E.M.F of this standard is a little more than one volt—viz., 1·079.

A POISONOUS LIZARD.

By Dr. Andrew Wilson, F.R.S.E., F.L.S.

THE possession of a poison-apparatus is by no means a common event in the animal world; although, indeed, very diverse animals are possessed of offensive means of this kind. Low down in the animal scale we find the jelly-fishes, sea-anemones, and their neighbours, possessing these curious stinging organs called "thread-cells," the virulence of which many an unwary bather has experienced to his cost. Each thread-cell is really a minute bag, tensely filled with fluid, and containing, coiled up in its interior, a thread or filament. When, from any cause—as by pressure, for example—the cell is ruptured, the fluid escapes, and if the thread and fluid together come in contact with the tissues of any animal liable to be affected, the animal in question will be paralysed, or even killed. In this way the *Hydra*, or "fresh-water polype," captures its prey; and even in the lower deeps of the animal world (as amongst the *Infusoria*, for example), these thread-cells appear to be represented. Higher up in the animal series, we come upon the poison-apparatus of insects, carried in their tails, as also is the "sting" of the scorpion. The centipede's poison-fangs are situated, on the contrary, in its mouth. Amongst the shell-fish, or *Molluscs*, no poison-secretions occur. In fishes, as the lowest Vertebrates, we certainly know of one or two cases in which an approach to a poison-apparatus is found. The frogs and toads, "ugly" as they may be, are yet not "venomous," Shakespeare notwithstanding. Acrid and irritating secretions may be poured out from the skin-glands of these animals. Such secretions are seen typically developed in the toads; but they are not "poisonous," in the common sense in which we use that term.

It is in the class of reptiles that the venomous attains its full development. Here, in the group of the snakes, we reach the acme of poison evolution. A typically poisonous snake, like the Rattlesnake or Viper, possesses two elongated and hollow "fangs," borne on its upper jaw. These fangs are merely largely-developed teeth, and their hollow interiors each communicate by means of a canal with the poison gland. This gland, placed in front of and below the eye on each side, is merely a modified *salivary gland*, and corresponds to that gland in man known as the *parotid*, and which becomes enlarged in children suffering from "mumps." It is highly interesting to find that whilst the poison-secretion of a snake is merely permanently modified *saliva*, we know of cases among quadrupeds in which the fluid of the mouth becomes temporarily venomous. The case of the rabid dog is the most familiar example of this fact; and it is curious to reflect on the similarity in nature which exists between the virus of animals so widely separated as are snakes and mammals.

The class of lizards is well known to be related to that of the snakes by many ties of structural kinship. Both are groups of the reptilian class, and we find certain lizards (*e.g.*, the harmless blind-worm of Britain), which may be as destitute of legs as any snake. No lizard, until within a few days since, was known to be poisonous, or to possess any structures suggestive of the possession and manufacture of a poisonous secretion. Horrible, ungainly and ugly as many lizards are, no fear of evil consequences could have been experienced in handling them, and naturalists would have given a very decided negative to any inquiry respecting the existence of a poison-secretion in the lizard-group. But as it is the unexpected which happens proverbially in political and social life, so zoological existence has been startled by the news that a truly poisonous lizard has at length been discovered.

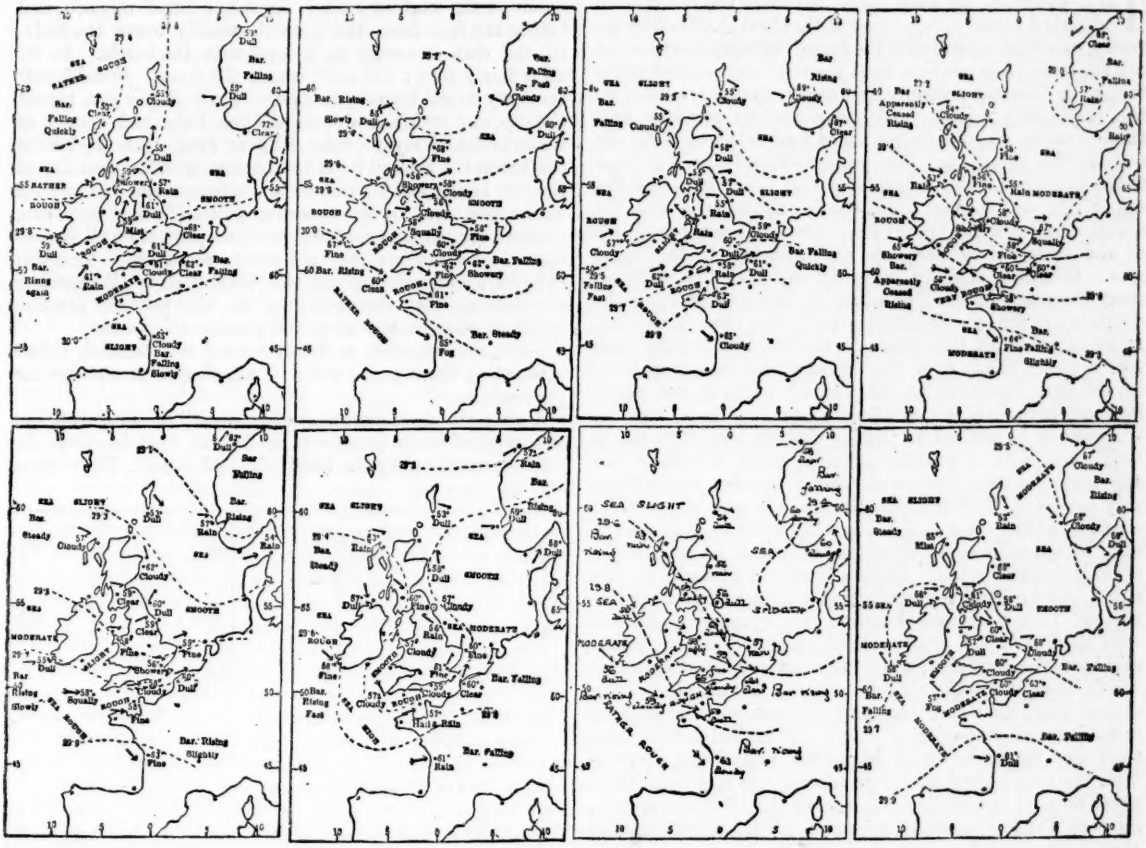
This lizard is named the *Haloderma horrida*, and hails from the neighbourhood of Puebla. It is, therefore, a denizen of the New World, and has found its way to the reptile house in the London Zoo' through the kindness of Sir John Lubbock. The traditions of the lizard are, it appears, unfavourable, if its Indian character is to be believed. The natives appear to regard it as a malignant deity, and are said to endeavour to propitiate the supposed evil power by the offer of sacrifices to the lizard-god. When first brought to London, the reptile was regarded as an interesting example of a rare species of lizard. Like the rest of its brethren, it was believed to be thoroughly and completely harmless. True, stories had now and then been circulated by travellers in Mexico, that there existed in that country a lizard, or reptile of allied nature, whose bite was believed to be terribly fatal. But naturally enough, without evidence of the existence of such an animal, naturalists relegated the story to the domain of legend and exaggeration. Without direct evidence of such a statement, no man of science, basing his knowledge of lizard-nature on the exact knowledge to hand, would have hesitated in rejecting the story as, at least, improbable. Yet it is clear that the stories of the New World may have had an actual basis of fact; for the *Haloderma horrida* has been, beyond doubt, proved to be poisonous in as high a degree as a cobra or a rattlesnake.

At first the lizard was freely handled by those in charge at Regent's Park, and being a lizard, was regarded as harmless. It was certainly dull and inactive, a result probably due to its long voyage and to the want of food. Thanks, however, to the examination of Dr. Günther, of the British Museum, and to actual experiment, we now know that *Haloderma* will require in future to be classed among the deadly enemies of other animals. Examining its mouth, Dr. Günther found that its teeth formed a literal series of poison-fangs. Each tooth, apparently, possesses a poison-gland; and lizards, it may be added, are plentifully supplied with these organs as a rule. Experimenting upon the virulence of the poison, *Haloderma* was made to bite a frog and a guinea-pig. The frog died in one minute, and the guinea-pig in three. The virus required to produce these effects must be of singularly acute and powerful nature. It is to be hoped that no case of human misadventure at the teeth of *Haloderma* may happen. There can be no question, judging from the analogy of serpent-bite, that the poison of the lizard would affect man. The sacrifice of a guinea-pig and a frog may be, and most probably will be, cited by rabid anti-vivisectionists as a cruel experiment. Sensible persons will apply another term to the test whereby the virulence of the lizard was established, and humanity thereby placed on its guard. Forewarned is forearmed, whether we consider the case of a burglarious attack on our premises, or the bite of a lizard.

Are Toads Poisonous?—The large wart-like glands on the head and back of the toad secrete a thick, yellowish-white fluid of an exceedingly acrid and offensive nature. If these glands are squeezed or roughly handled, the secretion is exuded through a number of pores, like pin-holes, in the surface of the glands. No doubt it is owing to this fact that the toad has gained its name as a venomous reptile.—W. B. Wicken.

WEATHER CHARTS FOR WEEK ENDING SUNDAY, AUG. 27.

SUNDAY, AUG. 20TH. MONDAY, AUG. 21ST. TUESDAY, AUG. 22ND. WEDNESDAY, AUG. 23RD.



THURSDAY, AUG. 24TH. FRIDAY, AUG. 25TH. SATURDAY, AUG. 26TH. SUNDAY, AUG. 27TH.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶, light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

THE PUBLIC HEALTH.

THE Registrar-General's weekly return shows that the annual rate of mortality last week in 28 of the largest English towns averaged 22·7 per 1,000 of their aggregate population, which is estimated at 8,469,571 persons in the middle of this year. The six healthiest places were Derby, Bristol, Halifax, London, Birkenhead, and Brighton. In London 2,554 births and 1,401 deaths were registered. Allowing for increase of population, the births were three and the deaths 94 below the average numbers in the corresponding week of the last ten years. The annual death-rate from all causes, which had slowly but steadily increased in the five preceding weeks from 17·7 to 20·5 per 1,000, declined again last week to 18·8. During the first eight weeks of the current quarter the death-rate averaged only 18·6 per 1,000, against 21·4 and 22·9 in the corresponding periods of 1880 and 1881.

The 1,401 deaths included one from small-pox, 27 from measles, 36 from scarlet fever, 18 from diphtheria, 40 from whooping-cough, one from typhus fever, 14 from enteric fever, one from an ill-defined form of continued fever, 158 from diarrhœa and dysentery, and six from simple cholera. Thus 302 deaths were referred to these diseases, being 77 below the corrected average number in the corresponding week of the last ten years. Different forms of violence caused 48 deaths; 42 were the result of negligence or accident, among which were 20 from fractures and contusions, 11 from drowning, 2 from poison, and 4 of infants under one year of age from suffocation. The 20 deaths from fractures and contusions were thus caused:—A male, aged 40 years, fell from a brougham; males 1, 4, 4, run over by van; male 6, crushed by van; male 27, run over by waggon; male 8, crushed by waggon; female 4, run over by tram-car; male 42, run over on London and South-Western Railway; female 2, fell from perambulator; male 2 and female 58, fell down stairs; male 35, fell from ladder; female 8, fell from window; female 92, fell out of bed; male 13, fell while at play; male 55 and female 45, by fall; male 25, crushed by machinery; and female 10, by blow of stone. An inquest was held in each of these 20 cases. Three cases of suicide were registered. In greater London 3,245 births and 1,760 deaths were registered, equal to annual rates of 34·6 and 18·8 per 1,000 of the population. In the outer ring the 55 fatal cases of diarrhœa corresponded with the number in the previous week, and included 20 in West Ham district. Of the 8 deaths from scarlet fever, 4 occurred in West Ham, and 3 in Tottenham sub-districts.

XUM

HOW TO GET STRONG.

TO STRENGTHEN THE MUSCLES OUTSIDE THE CHEST.

(*Continued from page* 181.)

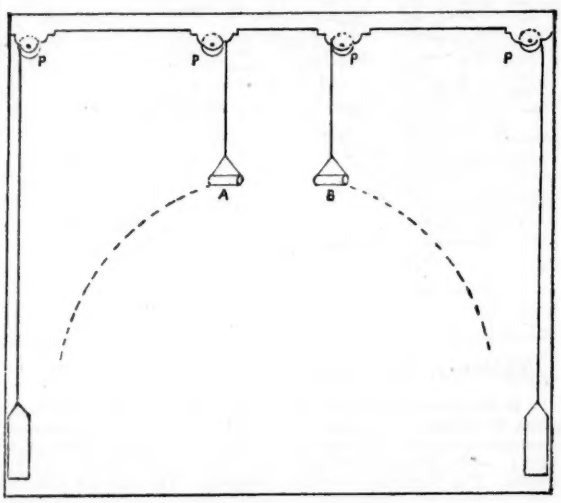
THE exercises we have hitherto considered have been directed to the enlargement of the chest itself—first, directly, by actual expansion of the frame enclosing the space we call the chest (I do not here limit the word to the front of the trunk, or breast); secondly, indirectly, by their action on the respiratory organs. We have now to consider how those muscles may be strengthened and enlarged which lie outside the chest, viz., the pectoral muscles, which have their origin near the breast-bone and inner edges of the upper ribs and are attached to the upper arm, and the dorsal muscles, which, rising from near the lower two-thirds of the vertebral column, are also attached to the upper arm. Speaking roughly, we may say that the pectorals carry the arms forward, as when we bring them upon the chest, while the dorsal muscles carry the arms backward, as when we finish the stroke in rowing. In boxing, both sets are very freely used, the dorsals when we prepare to hit out from the shoulder, the pectorals when we carry that laudable purpose into execution.

It should be noticed in passing that the development of both these sets of muscles often gives to the chest the appearance of being very well developed, when in reality it may not be so. This is especially the case with the pectoral muscles, which often are so developed as to suggest the idea of splendid chest development, when in reality the chest is flat and small. Blaikie very well remarks on this point, and we have repeatedly noticed the fact in the gymnasium, that "whoever knows many gymnasts, and has seen them stripped, or in exercising costume, must occasionally have observed that, while they had worked at exercises which brought up their pectoral muscles until they were almost huge, their chests under their muscles had somehow not advanced accordingly. Indeed," he adds, "in more than one instance which has come under our observation, the man looked as though, should you scrape all those great muscles completely off, leaving the bare framework, he would have actually a small chest, much smaller than many a fellow who had not much muscle. There hangs to-day—or did some time since—on the wall of a well-known New York gymnasium, a portrait of a gymnast stripped above the waist, which shows an exact case in point. The face of such a man is often a weak one, lacking the strength of cheek-bone and jaw, so usual in men of great vitality and sturdiness—like Morrissey, for instance—and there is a general look about it as if the man lacked vitality. Many a gymnast has this appearance, because he takes so much severe muscular work that it draws from his vitality, and gives him a stale and exhausted look, a very common one, for example, among men who remain too long in training for contest after contest of an athletic sort." It has been for this reason chiefly, that we have set first the exercises for enlarging and deepening the chest itself, as a matter more vitally important than the enlargement of any special muscles whatever. We can now, however, turn with advantage to exercises directed to enlarge particular sets of muscles.

The most effective exercise for strengthening the pectoral muscles is one which cannot be safely taken until these muscles are already tolerably well developed, viz., dipping from the parallel bars, or between the backs of two stout chairs. This exercise is usually given specially for the triceps muscles; but it depends even more on the action of the pectorals, insomuch that while men with strong pectorals and moderately strong triceps muscles can accomplish these dips pretty well, men with strong triceps and only moderately-strong pectorals often fail to accomplish a single dip without pain. To take the simplest form of the exercise:—Set two strong and rather heavy chairs back to back (you may with advantage put half-a-dozen heavy books on the seat of each.) Rest one hand on each, and lifting the feet from the ground, steadily lower the body, till the chin is nearly on a level with the hands. So far all is fairly easy; but now comes the work. Steadily lift the body to its former position. Then, if you can, repeat the dip, and continue dipping till you have had enough of it: it is not likely to take long at first. (The feet must not touch the ground from the beginning of the first dip to the end of the last.) But *do not attempt even a single dip unless you find, after lowering yourself, that you can, without very great effort and without pain near the breast-bone, begin and continue the rising movement.* You will only hurt yourself, and stop for several days all exercises directed to that strengthening of the pectoral muscles which is what, in this case, you particularly want.

Some such exercise as the following may be used, before attempting the dips, to test and afterwards to enlarge the pectorals:—

Using the instrument already described at p. 180, but the weights much heavier than for the exercise there described, stand under the handles A and B (fig.). Draw them



down till they reach the chest, and then change the hold, so that you can thrust them down on each side of you—that is, till the arms are extended straight down from the shoulders. Now slowly raise the hands, carrying them up slightly in front of the body till they reach nearly to the shoulder; then thrust them down again to their full extension. Repeat, making all the movements steadily and slowly, till you are comfortably tired. After a short rest, or turning for awhile to other exercises, return to this work, till you are tired with it yet once more. After a fortnight of such work, you can safely try your first dip; and once you have begun dipping exercise, there is no limit to the amount of work you can give the pectoral muscles in this way.

The following exercise is good for the upper parts of the pectorals:—Hold out a pair of tolerably heavy dumb-bells, one in each hand, so that the arms are extended horizontally on either side of the body; then slowly lower the dumb-bells a foot, and as slowly raise them two feet. Repeat

this for as many seconds as you find convenient. Do not try minutes, unless you feel that you *must*; but if you time yourself, using 10 lb. dumb-bells, you will feel no absolute obligation to continue the exercise after the first half-minute or so, especially in your earlier trials.

(To be continued.)

BOOKS ABOUT HEALTH.

THERE is no branch of literature in our day in which the activity is more constant than that devoted to popular instruction in the art of keeping healthy. There are periodicals devoted to it exclusively. Every year half a dozen books make their appearance, mainly at this season, telling us what to eat, drink, and avoid, how to live long, how to escape sickness, with sub-directions telling us how to chew, what time to go to bed, how many blankets we should sleep under, what sized pillow we should use, what time to rise, the proper temperature of our bath, how to rub ourselves on getting out of it, how often we should wash our feet, how much exercise we should take, and at what hour we should take it, what we should wear next our skin, and what kind of hat we should wear in summer. In fact, most of the books on health now closely resemble in minuteness of information the useful little manuals for mothers, regarding the care and treatment of children in the nursery, with which the world has so long been familiar. The adult who chooses to avail himself of them, consequently, need never take the smallest step in the care of his person without the best medical advice. There is nothing, from the brushing of his teeth in the morning to the blowing out of his candle at night, which he may not perform under professional judgment, without looking into the strictly technical books at all.

From one point of view the abundance of this hygienic literature is an excellent sign, because it shows the rapidly increasing attention of the medical profession to the art of prevention, which will probably before many years greatly overshadow, if it does not supersede, the art of cure, and which there is no doubt has of late outstripped the art of cure in efficacy, and stands higher in the estimation of all the older doctors. Telling people what to eat, drink, and wear, and how to work and play in any particular climate, is simply advising them, in Darwinian phrase, to adapt themselves to their environment so as to escape the remorseless law of natural selection, which makes such short work of those lower animals which pay no attention to hygiene, or are born with feeble constitutions or the wrong colour. But then there is the danger of giving people more advice about their bodies than their minds can bear, and to this the literary doctors are undoubtedly exposing us. They have done much good, especially among the women, who fifty years ago lived in violation of even the elementary rules of a healthy existence. They have improved people's food and clothing a good deal, and have almost effected a revolution in popular habits—in the matter of ventilation, for instance. But in the minuteness of the directions they are now giving about exercise, digestion, bathing, and the like, they are either deepening the morbid streak in the human mind, or leading people into mistaken and often injurious experimentation. Nothing, for instance, is more prejudicial to health than too much thought about health, and this the health literature of the day undoubtedly tends to foster. In fact, that it does not do more mischief among the men is probably due to the fact that most of them are so busy that they have no time to study their own sensations. An idle man who tried to regulate his life by the rules of any popular health manual, and watched the effect of his regulated food and his regulated exercise, would almost certainly become a hypochondriac; and that many who start with some trifling constitutional weakness do become hypochondriacs in this way there is little doubt; in fact, with regard to the body, as with regard to the soul, there is much danger in casuistry, and the rules of health are very apt to be the casuistry of the body. A man who ran to a spiritual director every day to find out the exact moral quality of each of his acts, and its bearing on his spiritual health, would soon find that there was but little spiritual health left in him, and the man who is constantly asking himself whether this or that is good for his body, and getting his answer out of a guide-book, is very likely to have an analogous experience. In fact, so true is this, that one of the conditions of health may be said to be the diversion of the mind from all thoughts about disease.

Another defect in the kind of literature of which we are speaking is the too great absoluteness of its teachings. There are but few health books, if any, read by the young. The young are generally well, and generally indisposed to introspection, either mental or physical. They find they can eat anything at any hour, and they find that the proper amount of exercise for them is the amount they like to take. They are not interested in indigestion or sleeplessness, or any of the other ills for which the books seek to provide. If one happens to be with a party of young men in which the subject of food, or drink, or clothing comes up, one finds that it is discussed wholly from the standpoint of taste. They exchange views about what they like and dislike, and are immensely bored by observations on the hygienic quality of their tastes. Rules of health, in fact, are seldom perused or called for by anybody below the age of forty—at which, as the proverb says, "every man is a fool or a physician"—that is, he is either a person on whom health preaching would be wasted, as it would be on a cow or a horse, or a person who has through experience accumulated a body of hygienic doctrine of his own which no doctor can shake. Go into any company of middle-aged men, and listen to a discussion of meat or clothing, and you find that the question of healthfulness dominates the discussion. Each man's contribution to it is apt to be in the main an account of his own experience of what "agrees" with him; that is, he passes judgment on food, on dress, on exercise, on bathing, on hours of sleep, according to his experience of his subsequent physical sensations. It is this class, in fact, which buys and reads most of the health books, because it is most interested in morbid conditions of the body. But it makes the health-books, with their *ex-cathedrâ* tone, very strange guides, when we discover that in such a company as we have mentioned probably no two men's experience is the same about anything. One finds unlimited cucumbers most refreshing, another the smallest piece of cucumber deadly poison. One finds tea late in the evening necessary to a good night's rest; another finds tea later than five o'clock in the afternoon fatal to sleep on the following night. One finds a light breakfast the best preparation for a good day's work, and a sure cure for rheumatism; another finds a hearty breakfast indispensable to any activity, either mental or bodily, and the only safeguard against dyspepsia. One cannot dine later than two p.m.; another is miserable if he dines before seven. One cannot drink coffee; another finds coffee essential. Early rising clears one man's brain; it makes another stupid and incapable all day. One finds a daily cold bath the making of him; another tried it once and nearly died of it. One needs two hours' daily exercise for any effective brainwork;

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another finds the less he takes the better he thinks. So it is about tobacco and about alcohol, and about bed blankets and about woollen undershirts, and about almost every habit, article of diet, or of clothing. Not only are there, in the matter of physical health, as many tastes as there are men, but apparent nearly as many requirements. In fact, if we go behind the health books to the sources from which the authors extract their conclusions, we shall find that almost the only certain and unassailable rule of hygiene which will bear universal application, is that pure air is good for the human animal, and that the more of it he has the better. All else is doubtful and disputed, or weakened by inscrutable peculiarities of individual constitution.—From the *Nation*.

Spontaneous Combustion of Cotton.—During one of the hot days of June, a Connecticut lady thought she smelled something burning upstairs. In searching for the fire she entered a small close garret room used for storage. She opened a window, and instantly a bag of carpet rags hanging there burst into flame. The rags had been there all winter. The fire was promptly smothered; and when the bag was opened it was found that only balls of cotton rags were burned. Whether the rags had been dyed is not stated.

Miss Amelia B. Edwards has received a letter about Prof. Maspero, dated August 13, from which the following is extracted:—"As for Maspero, I have news of him from his brother. Notwithstanding that our consul, M. Monge, urgently recommended him to leave as long since as July 8, he persisted in remaining at Boolak, where he was working day and night upon the completion of the new rooms lately added to the museum. For these rooms he had but lately received the necessary credit which should enable him to decorate and fit them up. On the 13th, however, our Minister of Public Works, under whose control he acts, despatched a formal order for his immediate departure. Despite this order, I believe he would still have remained had he been alone; but he had with him his young wife, who is but just recovering from a severe illness, caused by the extreme heat on board the steamer in which they have been living, and his mother-in-law, Madame la Baronne d'Estournelles (the mother of our *chargé d'affaires* at Tunis), and these ladies refused to desert him. The railway lines of the Isthmus were threatened; his brigade of soldiers had been withdrawn; and his steamer was in danger of being requisitioned for purposes of war. This boat was his only home. The hotels were empty and shut up. The European shops were all closed. He had no resource but to obey. He has left the museum in charge of his Nazir, the faithful Kourschid-Effendi—a brave old Circassian, who was especially valued by Mariette on account of his energy and integrity. All the precious relics in wrought gold, and everything which might tempt the cupidity of mere spoilers, have been removed; and I think there is nothing to fear from ordinary thieves; but, if it comes to burning, pillaging, and assassination, as at Alexandria, I do not see how even Maspero's presence would avail to defend the building. As in war-time a house which it is particularly sought to protect is converted into an ambulance, the old tumble-down dwelling in which Mariette lived has been assigned to some Arab hareems . . . . It was not possible for M. Maspero to remain at Ismaïliah; he has therefore started for France by way of Italy, where he is at the present moment. He is expected to arrive in Paris about the 20th inst., where he will hold himself in readiness to return to his post as soon as such return is possible."

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of Knowledge: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday*.

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig*.

ALCOHOL AND INHERITED VICES.

[530]—I am rather amused on reading the little sermon with which my friend Mr. Proctor has supplemented my letter, No. 514, page 201, especially with the latter part as applied to myself. My own position, as explained in my penultimate paragraph, is rigidly logical. How Mr. Proctor can approve of the rest of my letter and find fault with this is inscrutable. If I am right in what I stated as the results of my experiments and observations, the drinking of wine or beer, or tea or coffee (except as medicines when ill), is a pure vice, a *physical* vice, of course. Its essential nature remains absolutely the same, whether it be big or little.

I said "folly or vice," using the synonym to prevent that misunderstanding of my meaning into which Mr. Proctor has evidently fallen. He reads the word "vice" as implying immorality. I used it properly, in accordance with the definition which I find on referring to the first dictionary that comes to hand, viz., "a defect, fault, blemish, or imperfection."

Having stated my own case, I say, "If all would do this," &c. Here, perhaps, I ought to have been more explicit, in order to except those who really do believe that alcohol is the "concentrated nutriment" described by Dr. Epps, or who have disinterred the dead and buried paradox of Liebig, who imagined that certain drugs may increase the activity of the animal machine by checking the waste of its tissues.

I am as well satisfied that alcohol, nicotine, morphia, theine, caffeine, &c., are not constituents of the healthy human brain, or any other part of the healthy human frame, as Mr. Proctor is of the rotundity of the earth, and when I hear of a man proposing to improve a sound brain or sound body by the addition of any of these, I regard him as Mr. Proctor would regard John Hampden, had he contemplated an excursion to the limits of his flat earth in order to peep over its boundary edge.

This, as I said, does not prevent me from taking a cup of tea or glass of wine occasionally, but I do so as I do a thousand other things, from purely sensual motives, and not from any high moral or intellectual convictions. I recommend others to admit that they are not angels, that they are not always influenced by purely moral, intellectual, and spiritual motives. If we thus frankly acknowledge the true character of our many small vices, their growth would be materially checked. This is especially the case with inherited vices.

I will cite only one example. Our Universities, our public and private schools and colleges, have inherited from the middle ages the dirty fables of the Greek mythology and the Latin poets. Instead of treating these as we treat the corresponding literature of Holywell-street, they are described as conducive to "culture," &c. Everybody who dares to think freely, and is capable of doing so, knows that this is humbug, however "respectable" it may have become. We know that the stated reasons for retaining the dead languages in their present educational position are not reasons at all, but mere apologies. The dead languages were not introduced for the purposes which they are now said to serve; they are mere educational inheritances sustained by the fact that the majority of teachers know little else. If these men, instead of hunting up virtuous descriptions of their own intellectual vice (see definition of this word quoted above) had frankly admitted its true character, their natural ambition and desire to do right would have led to their better qualification, and have swept away this monstrous educational incubus in the course of a single generation. The same with a

multitude of minor vicious inheritances that are sustained and enforced by conventional pressure; they would all yield to vigorous self-scrutiny and frank admission of actual motives.

W. MATTIEU WILLIAMS.

[I thought it would be clear enough to Mr. Williams that whatever in my remarks may have read like sermonising, was not applied to him. But he mistakes in supposing he had proved the folly or vice (whether in his own or the usual sense) of taking an occasional glass of wine or smoking an occasional cigar. He has proved by his own experience (and really only in his own case, but let us take it as proved generally) that to anyone taking much exercise in the open air, alcoholic stimulants taken daily are useless, and worse. He has not proved, or gone anywhere near proving, that an occasional glass of wine or beer does any injury whatever to any, far less to all; until this is proved, nothing has been done to show that there is either folly or vice in taking a glass of wine. If it is pleasant to take a glass of good wine, and Mr. Williams admits it is, and if it does no harm whatever, and he has not shown that it does, the balance of advantages is in favour of taking it, in just such degree as is found to be innocuous. That some persons who lead a sedentary and studious life absolutely require an occasional glass (not necessarily even one a day, but one at times) is believed by many who know much more about human physiology than either Mr. Williams or myself. A learned friend of mine to whom I mentioned a few years ago that for more than a year I had taken no stimulants whatever, warned me from his own experience against a course which he considered (but I do not) to be full of danger. But this, after all, is not the point. The question is, is it or not innocuous to take an occasional glass of wine, or spirits, or beer. Until it is proved that it is not, and cannot be innocuous, I hold that there can be no folly—for those who can readily afford the indulgence—in taking the glass, whenever it suits our convenience and gives us pleasure, to do so. The definition of vice quoted by Mr. Williams is a special one—no more the usual one than the other definition, according to which a vice is a character in old mystery-plays. Mr. Williams would find, I think, that if he said a man had a "vice" the general meaning put on the word would not be precisely that which it bears when, for instance, I speak of the "vice" of Mr. William's mode of reasoning in this alcoholic question.—RICHARD A. PROCTOR.]

BICYCLES AND THEIR DEFECTS.

[531]—Having been a bicycle rider for nearly fifteen years, and riding during that time all kinds of bicycles, from the 34-in. bone-shaker—upon which I rode forty and fifty miles a day many times with the greatest pleasure—to a 55-in. modern Stanley-tread spider machine, and having read everything upon bicycling that I could get, I think I am in a position to state some of the defects of the modern bicycle. The principal defects in the old-fashioned machine were the weight and appearance. In the modern bicycle these defects have been removed, but, in carrying out the remedy, bicycle makers have gone to the extreme. To reduce the weight the spring of the bicycle has been almost done away with, and the back wheel reduced almost to a castor.

The modern bicycle has many advantages over the old-fashioned one, the increased number of spokes, and the ball bearings, and the lighter weight behind; but these I need only mention as I wish to speak of the defects. I consider the greatest defect in the modern bicycle to be the very short spring, which causes the rider to experience, when riding over rough ground, a continous jar or vibration, almost as bad as when riding in a cart without springs. When I rode a bicyle with a long elastic spring the machine ran over the rough ground easier than with the short spring bicycle of to-day, and there was no vibration, and I could see objects around distinctly. With a short spring the objects have a tremulous appearance except when riding on very smooth roads. Another defect in the modern bicycle is the very small back wheel. A small back wheel will not run over inequalities so easily as a large one. The experience of modern bicycle-riders is, as a rule, that their bicycles shake them a good deal. I believe the cause to be the very small back wheel. Bowl two iron hoops, a 10 in. one and a 50 in. one over rough ground, and watch the motions of both, and see which runs the steadier. Another defect is a very small saddle. If a man wants to "sit at ease" he chooses an easy chair, and not the top of a post to sit upon; the same holds good with a bicycle-saddle. If, therefore, bicycle-riding is to be a pleasure, I conclude that the spring must be as long again as now made, and the back wheel must be 20 in. to 24 in. in diameter. Bicycle-makers have perfected the machine for racing purposes on the track or path, but they have forgotten that all bicycle riders are not sportsmen and racers. In making machines, let them study ease in propulsion and comfort in riding, and there will not be so many give up riding after a few runs as there now are. My longest journeys, and those done with the greatest ease and pleasure, were on a 48-in. "Challenge," with a long spring and a 20-in. back wheel, which machine was made in the year 1875.

CALEB ADAMS.

FAIRY RINGS.

[532]—I would respectfully suggest to Mr. Mattieu Williams that his theory of the cause of these interesting phenomena does not account for the appearance of fairy rings in pastures. I have in my mind several pastures (where in all probability the grass had been grazed by sheep for many years) in which these rings were common; and, if I am not mistaken, the common "puff ball" is the fungus these rings produce. May not the rings be produced from a central point? Say a nucleus of fungus, takes root in the turf. The peculiar adaptability required in the soil for their growth becomes annually exhausted, and the plant (if I may so call it) extends its roots into the fresher soil in an ever-extending circle. If some of our country observers and botanists would look for these rings in pastures, and ascertain if they are found in circles of varying circumference, I should be inclined to think that fact would go far to prove my theory.

The green colour of the grass, "Whereof the ewe not bites," in my opinion is the effect of the fungus itself, and not of any local excess of manurial matter; but I fancy some of our botanical readers can tell us all about the matter, for I have a vague recollection of seeing an account of the nature of fairy rings in some botanical work.

W. B. WICKEN.

[533]—Mr. Mattieu Williams, in attempting to disprove Mr. W. G. Smith's explanation of the origin of fairy rings says that "the large fairy rings on the South Downs have been explained over and over again as the result of special manuring in the boundary track of tethered animals." Now this cannot apply to the South Downs in this neighbourhood. On the hills about Lewes fairy rings of all dimensions, up to more than 50 ft. in diameter, abound, and it is well known that cattle are never pastured on these hills, whether tethered or otherwise; the only animals fed are sheep, which roam in any direction. I have for years watched these rings, which, in the autumn, are always accompanied by fungi, the fungi growing outside the crop of rank grass. When these fungi decay they supply a highly nitrogenous manure to the ground where they grew, consequently their place is occupied the succeeding year by rank grass, and the fresh fungi are again uppermost, that being the only place where their spores can germinate. Thus the increasing size of these rings is explained and as easily witnessed, and we can see that a single fungus is capable of starting a ring which may grow to very large dimensions.

J. H. A. JENNER.

HOT AND COLD DRINKS.

[534]—In reply to J. Williams, jun. (498), allow me to state that cold drinks are natural to man, though most humans now-a-days are so used to hot drinks, that they do not feel satisfaction—really stimulation—unless they have them. Hot drinks are injurious to the tongue, teeth, gullet, and stomach.

They are injurious to the tongue, for they deaden its sensation, and, after taking hot soup or drink, the tongue becomes quite numb, and unable to taste the finer flavours of a dish.

The teeth are greatly injured by them, and many dentists say caries (decay) is due to them alone. They crack the enamel, and thus allow caries to set in. When caries has once set in, hot drinks are a common cause of neuralgia. Who has a bad, unstopped tooth, who has not often had face-ache from a hot drink?

Again, experiments were made on cows; some were given food cold and some hot. Those who got it hot soon showed signs of caries of the teeth.

Hot drinks cause a slight dilation of the bloodvessels of the gullet, and scalding hot drinks cause stricture of the gullet. They are specially hurtful to the stomach. They cause irritation of the nerves of the stomach, and consequent mild inflammation of that organ, so that after a hot drink the stomach is red and congested; in time a debilitated condition is set up.

A temperature of 100 Fahr. also destroys the active ferment of the gastric juice—pepsin, and so leads to indigestion.

In China, where hot drinks are the rule and water the exception, the people are subject to hematemesis (vomiting of blood), said to be caused entirely by their habit of taking hot drinks.

If the stomach is at all disordered, hot drinks give rise to much griping pain, and in many cases to vomiting. In cases of diarrhœa, too, hot drinks only increase it, whilst cold ones tend to lessen it.

In answer to the second part, thirst is not common in winter, unless sugary, salty, or hot spiced foods have been taken. In cold

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weather the air contains more moisture than in hot, and in cold weather we do not perspire so much, as can be seen from the extra amount of water otherwise removed from the system. Hot drinks increase the volume of heat in the body, and if that is not required, we quickly get rid of it by the skin, hence much perspiration in hot weather during tea-time.

Water is the best thirst quencher, but if simple food be taken, the need of drinks will be very small. I know many vegetarians who do not drink anything from month to month, the only fluid they get being the juices of the fruits which they eat.

But these pleasant drinks may be taken lukewarm for a very long time with very little apparent damage. The least injurious is cocoa, made with plenty of milk, and allowed to stand until nearly cool. A good test is to apply the little finger to the drink, and if it be not hot to it, then it may safely be taken.—Yours truly,

Aug. 4, 1882. T. R. Allinson, L.R.C.P., &c.

TIME OF FULL MOON.

[535]—By means of Professor De Morgan's "Book of Almanacks," I have calculated, for your correspondent, that the time of full moon in July, 1573, was at or about 8 p.m., on Tuesday, July 14.

Henry M.

Answers to Correspondents.

*** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* Knowledge, *the increasing circulation of which compels us to go to press early in the week.*

Hints to Correspondents.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

D. W. Turner. I am sorry, but there is absolutely no space for articles on the Turkish and Egyptian matters you mention.—Rev. T. F. D. Thanks for pointing out shortcomings as to astronomical matter. So many had said there was too much.—W. Napier. If you use a Nautical Almanac the directions will be rather complex, as follows:—To make a morning tide-table for Ipswich, take the second column of tidal hours for London from the Nautical Almanac, wherever the hour in that column exceeds 13 h. 23 m.; and deducting 13 h. 23 m., you get the morning tide hour for the day following that named. Thus you find opposite February 7, in second column, 20 h. 37 m.; from this deduct 13 h. 23 m., giving 7 h. 14 m. This is the morning tide hour for February 8 at Ipswich. When the hour lies between 12 h. and 13 h. 23 m., deduct 1 h. 23 m. from the hour in the left hand column increased by 12 h. This is the morning tidal hour for the day named. Thus, opposite Jan. 12, 1881, you find in the two columns 0h. 4m., and 12h. 33m., take then from 12h. 4m., 1h. 23m., giving 10h. 41m., which is the morning tide hour at Ipswich on January 12. For the afternoon hours, take the tidal hours in the first column where they exceed 1h. 23m., and so get afternoon tidal hours for the day named—as on Jan. 22, 1881, where 6h. 11m. is named, the afternoon tidal hour at Ipswich is 4h. 48m. Where the hour named in first column is less than 1h. 23m., take the second column, and diminish by 1h. 23m. Thus, for Jan. 12, 1881, where hour in second column is 12h. 33m., you get 11h. 10m. for the afternoon tide at Ipswich. If, however, you have, what everyone should have, a Whitaker's Almanac, you can do all this much more simply, by taking 1h. 23m. from the hours named for high tide at London Bridge, in a page devoted to the tides for each month. I have given the rule for *Nautical Almanac*, not knowing how early you may wish to get out the tide times at Ipswich.—Fidei Defensor. Meteors cannot leave their course and travel around a planet, unless, encountering the planet's atmosphere, their velocity is considerably diminished. Apart from such frictional resistance, whatever effect the planet may have in drawing the meteors towards itself will generate a velocity which will help to carry the meteors away from it.—Trifler. Pardon me, but is there not some mistake? I do not quite see the sophism. In the course of the analysis 0^{-2} is treated as equal to 0, but this is not correct—an incorrect mathematical process can hardly be called a sophism.—W. M'Manus. You think the "publishers of this publication" unfair in charging 2d. for the index, and say that other papers do not do the same. You are evidently not aware that in what we have done (for the matter was left as much in my hands as in theirs) we have been very much fairer than the publishers of other periodicals, or, rather, we have been unfair to ourselves. Take the *English Mechanic*. It charges its subscribers (and most fairly) 2d. yearly for index; we have charged them nothing. It prices the index number at 3d., so that every one has to buy the index who takes in the *English Mechanic* regularly, whether he wants to bind the back numbers or not (and not one in six wants to do so). Our publishers supply those only who want the index. The index would be very profitable if priced at one penny, and included with a 32-page number priced at 3d.; and still more profitable if, as in *Nature* and some other weeklies, it simply occupied so much space in a number of the usual size. As it is, though the publishers *do* charge other than subscribers 2d. for the index, its publication does not cover its cost. This, I imagine, will satisfy yourself and the other readers you speak of. I must confess supporters of that kind are disheartening enough. A publication is started on the most generous terms to readers and contributors (I venture to say no publication of the same kind has ever been started on so generous a plan), yet a certain section of its readers raise objections on every paltry point they can think of, mostly in utter ignorance of the real state of things. Thus we are asked, after we have been in existence a certain time, to oblige some readers by publishing monthly parts; the publishers find that for the additional expenses, as well as risk in keeping back so many single numbers to make up parts, the price of each monthly part must be 2d. beyond the price of the single parts included in the month: immediately an outcry is raised over this paltry 2d., which does not in reality compensate for the cost of our attempt to oblige monthly subscribers. We are asked for an index, and the publishers immediately make a present of it to subscribers, and charge those who care to buy it separately 2d. per copy, losing money by the arrangement, because five-sixths of the readers of journals like this do not bind. For thus bringing a loss on themselves in trying to oblige readers, they get such thanks as your letter conveys. Let me once for all point out that the object of Knowledge was to supply sound and clear scientific writing by leading writers at a very low price to readers, and at a better price than has been usual in such cases, to writers. I, as editor, gave to Knowledge time and work, worth to me ten times as much as I could possibly hope to receive for my services. I am ready to continue this; I am anxious to see the publishers responding to every advance we make by giving better and better matter to readers, better and better terms to writers. They share these views with me. But conceive how encouraging we find it under these circumstances to receive letters showing such kindly feeling as yours, such thorough appreciation of what we have tried to do.—A Student. Much obliged, but not one in a thousand of our readers would care for quaternions.—B. M. It is singular how difficult you seem to find it to understand my position. Can you not see that I have nothing to do with the cruelties of continental vivisectionists? I have reviewed what Prof. Owen has said as to his own opinions, which seem to me reasonable and sound. Why should I be guilty of the impertinence of asking him whether he abominates, as he ought to do, certain atrocities of which he does not speak? I take it for granted that he does, and that so also does Prof. Huxley, but to ask either whether they do would simply be to insult them. You say that I am unwilling to show both sides of the question; permit me to point out that I show neither side, but the middle.—H. A. Bulley. Pardon me, I believe sufficient attention *has* been given by science to the influence of the moon on the weather, with the result of showing there is none. Saxby's Almanac I have tested myself, with the result of finding that whatever in it is new is not in the least true, except by accident; what is true and trustworthy in it can be found in Whitaker's Almanac.—J. Sanders. You take Mr. Williams too much in earnest. Drunkenness is certainly an evil, and every man should do his best in his own circle to diminish it as far as possible. It would be as reasonable to sow the seeds of plague and pestilence as to wilfully encourage drunkenness; and you may be sure Mr. Williams meant nothing of that kind. His vein of humour is too subtle for many of our readers.—Ignoramus. I do not know how Cetewayo should spell his name, and, "not to put too fine a point upon it," I do not care. It is bad enough to fight the "nigger" kings; but to talk of them, about them, or with them (I speak from experience, having been a fellow passenger of one of the charming lot), is a little too much. To see our nigger king come on board with a garland of leaves round his neck, and attended by white men (some were Americans, too), made similarly ridiculous, while his gallant army of full 150 stood in single line, or marched to the strains of "Pinafore;" to hear his attendants, one at least among whom was a gentleman by birth and standing, address him as "Your Majesty," and even some of the passengers followed suit, and then to gauge his intellect, and find it as shallow as a negro barber's in a one street village, out West, was enough, in my humble judgment, to sicken the conventional dog. Yet, after all, it was but a small-scale copy of what happens sometimes outside of Zululand and the Sandwich Islands.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. IX.

BY RICHARD A. PROCTOR.

TWO functions still remain to be dealt with, $\log x$ and a^x, after which the student will be able to differentiate any functions whatever, simple or complex.

First, then, let $y = \log_a x$. Increasing x to $x + \Delta x$, whereby y is increased to $y + \Delta y$, and then subtracting, we have

$$\Delta y = \log_a (x + \Delta x) - \log_a x$$
$$= \log_a \left(\frac{x + \Delta x}{x}\right)$$
$$= \log_a \left(1 + \frac{h}{x}\right) \text{ writing } h \text{ for } \Delta x, \text{ for convenience.}$$
$$= \frac{1}{\log_e a}\left[\frac{h}{x} - \frac{h^2}{2x^2} + \frac{h^3}{3x^3} - \&c.\right]$$
$$\therefore \frac{\Delta y}{\Delta x} = \frac{1}{\log_e a}\left[\frac{1}{x} - \frac{h}{2x^2} + \frac{h^2}{3h^3} - \&c.\right]$$

Now when h is very small, all the terms within brackets, except the first, may be neglected, for they are less in absolute value than

$$\frac{h}{2x^2}\left[1 + \frac{h}{x} + \frac{h^2}{x^2} + \&c.\right]$$
$$< \frac{h}{2x^2} \div \left(1 - \frac{h}{x}\right)$$
$$< \frac{h}{2x(x-h)} \text{ a quantity vanishing with } h.$$

Hence, finally, when Δy, Δx are both indefinitely small, we have

$$\frac{dy}{dx} = \frac{1}{x \log_e a}$$

It follows that if $y = \log_e x$

$$\frac{dy}{dx} = \frac{1}{x}$$

Next let $y = a^x$. Here we shall content ourselves by proceeding as follows:—

$$x = \log_a y$$
$$\therefore \frac{dx}{dy} = \frac{1}{y(\log_e a)} = \frac{1}{a^x \log_e a}$$
$$\text{and } \frac{dy}{dx} = a^x \log_e a.$$

[There is in reality no objection to regarding $\frac{dy}{dx}$ as the reciprocal of $\frac{dx}{dy}$, however true it may be that $\frac{dy}{dx}$ is to be regarded as a single expression.]

It follows that if $y = e^x$

$$\frac{dy}{dx} = e^x \text{ also.}$$

We can now differentiate any expression we please, however complex. There is scarcely ever any room for much ingenuity in the choice of methods in differentiating. Still at times we find that space is saved, and we avoid the chance of errors in writing, by modifying our method of procedure.

Here are a few examples of differentiation:—

1. Let $y = x(a^2 + x^2)\sqrt{a^2 - x^2}$

Here, proceeding on the straightforward course, we get

$$\frac{dy}{dx} = (a^2 + x^2)\sqrt{a^2 - x^2} + 2x^2\sqrt{a^2 - x^2} - \frac{x^2(a^2 + x^2)}{\sqrt{a^2 - x^2}}$$
$$= \frac{a^4 - x^4 + 2a^2x^2 - 2x^4 - a^2x^2 - x^4}{\sqrt{a^2 - x^2}}$$
$$= \frac{a^4 + a^2x^2 - 4x^4}{\sqrt{a^2 - x^2}}$$

But we might have proceeded thus:—

$$\log y = \log x + \log(a^2 + x^2) + \tfrac{1}{2}\log(a^2 - x^2)$$

$\therefore$ differentiating with respect to x

$$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{1}{x} + \frac{2x}{a^2 + x^2} - \frac{x}{a^2 - x^2}$$
$$= \frac{a^4 + a^2x^2 - 4x^4}{x(a^2 + x^2)(a^2 - x^2)}$$
$$\therefore \frac{dy}{dx} = \frac{a^4 + a^2x^2 - 4x^4}{\sqrt{a^2 - x^2}}$$

2. $y = \log(\log x)$

$$\therefore \frac{dy}{dx} = \frac{1}{x} \frac{1}{\log x}$$

3. $y = \log(\log[\log x])$

$$\frac{dy}{dx} = \frac{1}{x} \frac{1}{\log x} \cdot \frac{1}{\log(\log x)}$$

4. $y = a^{x^x}$. Here we treat x^x as the variable exponent.

$$\therefore \frac{dy}{dv} = \log a \cdot a^{x^x} \cdot \frac{d}{dx}(x^x)$$
$$= \log a \cdot a^{x^x}(x x^{x-1} + x^x \cdot \log x)$$
$$= \log a \cdot a^{x^x} x^x (1 + \log x).$$

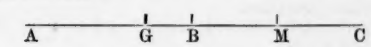
5. $y = a^{\log x}$

$$\frac{dy}{dx} = \frac{\log a \cdot a^{\log x}}{x}$$

6. $y = x^{x^x}$

$$\frac{dy}{dx} = \log x \cdot x^{x^x} x^x (1 + \log x) + x^x (x^{x^x - 1})$$
$$= \log x \cdot x^{x^x} x^x (1 + \log x) + x^{x^x} x^{x-1}$$

I have occasion for a hearty laugh at a mistake of my own, of a full size—nay, overgrown. Gulliver tells us that the tailors of Laputa measured folk for their clothes by mathematical methods—observing altitudes, triangulating, and so forth, but that generally some mistake in the computation caused the clothes to be exceedingly ill-fitting. I made the captain of a racing eight calculate by the differential calculus the proper size for one of his crew, but a very bad blunder made him obtain a wrong result. And really the blunder was *so* bad that the wonder is he did not deduce by the differential calculus a man two feet or twenty feet high, which might have involved him in difficulty. An odd thing is that my blunder was made eleven years ago, the problem having originally appeared in my short series of Easy Lessons in the *English Mechanic* (which lessons must have interested many, seeing that no one noted the mistake; thirteen readers of KNOWLEDGE have already pointed it out). In our columns the problem was simply reprinted and corrected from the printed original: (I think an additional error crept in; but have no means of knowing, being away from my back volumes of the *English Mechanic*.) The solution should, of course, have run thus:—



Let AM (breadth of man) $= 2x$; man's weight $= mx^3$; moment of his weight around centre line of boat's length $= mx^3$. GB $= mx^3(1-x) = mx^3 - mx^4$. Therefore $\frac{dy}{dx} = 3mx^2 - 4mx^3$; and equating to zero, $x = \frac{3}{4}$, or AM $= \frac{3}{2}$; so that since a man 1 ft. broad weighs, according to our assumption, 6 stone, our new oarsman should weigh $6\left(\frac{3}{2}\right)^3 = 8\frac{1}{4} = 20\frac{1}{4}$ stone.

I need hardly say that if, eleven years ago, my solution had been correctly obtained, with this ridiculous result, I should have slightly modified the conditions. For instance, I might have assumed that a one-foot seat corresponded to a weight of 4 stone instead of 6, in which case the reasonable weight $13\frac{1}{2}$ stone would have resulted for the new oarsman.

The value of the differential calculus is not affected by my mistake, which, however, teaches the value of care, especially in dealing with very easy problems.

A. W. Bawtree, one of the thirteen who note the above mistake, points out the following clerical errors in the Easy Lessons (I am only able to check his corrections for articles in Part 10, being away from home, and not having Part 9 by me):—

p. 136[1], l. 14 from bottom, 1,000 should be 10,000.

„ l. 13 „ „ y should be x.

p. 154[2], l. 8, $\tan x$ and $\tan(x + \Delta x)$ should be $\cot x$ and $\cot(x + \Delta x)$.

p. 155[1], l. 2, $\frac{dy}{dy}$ should be $\frac{dy}{dx}$

p. 171[2], bottom line, "functions of z" should be "functions of x."

p. 188[2], l. 18 from bottom, the equation should be

$$\frac{dy}{dx} = \frac{2x}{2(a^2 + x^2)^{\frac{1}{2}}}$$

p. 204[1], l. 21 from bottom, 5 = &c., should be y = &c.

Most of these are obvious misprints, but they should be corrected in the text.

XUM

Our Chess Column.

By MEPHISTO.

GAME PLAYED A FEW DAYS AGO AT MEPHISTO'S ROOMS.

SCOTCH GAMBIT.

WHITE. Mephisto.	BLACK. Amateur.	WHITE. Mephisto.	BLACK. Amateur.
1. P to K4	P to K4	16. B to B4	Q to Q2
2. Kt to KB3	Kt to QB3	17. Kt to Q5	Kt to K4 (*i*)
3. P to Q4	P takes P	18. B takes Kt	P takes B
4. Kt takes P	P to Q3 (*a*)	19. Qtks R(ch) (*j*)	B takes Q
5. Kt tks Kt (*b*)	P takes Kt	20. R takes B (ch)	K to Kt2
6. B to Q3	P to Kt3 (*c*)	21. R(Qsq) to KBsq	B to R3 (*k*)
7. Castles	B to KKt2	22. Kt to B6 (*l*)	Q to K2 (*m*)
8. P to KB4	Kt to K2 (*d*)	23. Kt to R5 (ch)	K to R3
9. P to B5 (*e*)	P to B3	24. R(B8) to B6 (ch)	K takes Kt
10. Kt to QB3	Castles	25. R(Bsq) to B5 (ch)	K to Kt5
11. Q to B3	P to Q4	26. B takes B (*n*)	P to B5 (*o*)
12. B to K3 (*f*)	P to Q5 (*g*)	27. B takes P	P to Q6
13. QR to Qsq (*h*)	K to R sq	28. B takes P	Q to B4 (ch)
14. B to QB4	P to B4	29. K to B sq	resigns (*p*)
15. P takes P	Kt takes P		

NOTES.

(*a*) It is not a very easy thing to support an opinion based upon general principles only; this move calls for an adverse criticism of the same nature. It brings the position somewhat analogous to a Philidor's defence, which, in itself, is weak. Black's King Bishop is blocked in, and his game will soon assume a cramped aspect.

(*b*) There is nothing to be gained by 5. B to QKt5, as Black will reply with 5. B to Q2; but by first exchanging Knights (to prevent Kt to QKt5) and then playing 6. B to Q3, White creates a break in Black's game, and furthers his own development.

(*c*) This seems best for Black.

(*d*) We think 8. P to Q4 would have given Black more freedom of action if White replied with Kt to B3. Black would take the Knight, or in reply to Q to B3 Black might have played Kt to K2.

(*e*) Somewhat premature.

(*f*) 12. P takes QP, followed after P takes P by 13. P takes KtP was sound play.

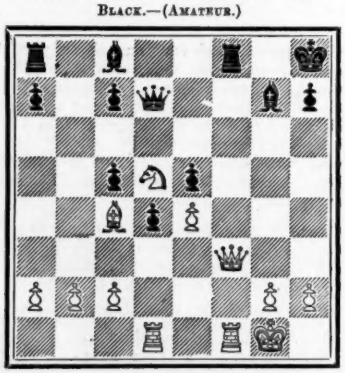
(*g*) Black fell into the trap which White set, at some considerable risk to his own game, for Black might have obtained a good game by 12. P takes KP, followed by B takes BP.

(*h*) This move gives White a superior game. Black cannot take the piece, on account of B to B4ch winning the Queen.

(*i*) If 17. Kt takes B, 18. Q takes Kt, R to B2, 19. Kt to K3, R to Bsq, 20. Kt to B5 with a good game.

POSITION AFTER BLACK'S 18TH MOVE.

BLACK.—(AMATEUR.)



WHITE.—(MEPHISTO.)

(*j*) White by this sacrifice brings about an interesting ending. We give a diagram.

(*k*) It is, of course, essential for Black to prevent the attack of both Rooks on his King, the move in the text is not without ingenuity. White can, of course, win the Black Queen, but he would not gain much by that course, *i.e.*—

22. $\frac{\text{R to B7 (ch)}}{\text{Q takes R.}}$ 23. $\frac{\text{R tks Q (ch)}}{\text{K takes R}}$ 24. $\frac{\text{Kt tks BP (ch)}}{\text{B takes B}}$ 25. $\frac{\text{Kt tks R.}}{\text{B takes P}}$

and Black has a good game. Or if White should win the exchange, which Black offers him, he would not fare any better, *i.e.*,

22. $\frac{\text{R takes R}}{\text{B takes B}}$ 23. $\frac{\text{R (Bsq) to B8}}{\text{B takes Kt}}$ 24. $\frac{\text{P takes B}}{\text{Q takes P}}$ and again Black has a fair game.

(*l*) This move wins by force.

(*m*) Even giving up the Queen would not help him, *i.e.*,

22. $\frac{}{\text{R takes R}}$ 23. $\frac{\text{Kt takes Q}}{\text{R takes R (ch)}}$ 24. $\frac{\text{B takes R}}{}$ and White wins by being a piece ahead.

(*n*) Decisive. 26. P to R3 (ch) would be less certain, as no mate can be forced.

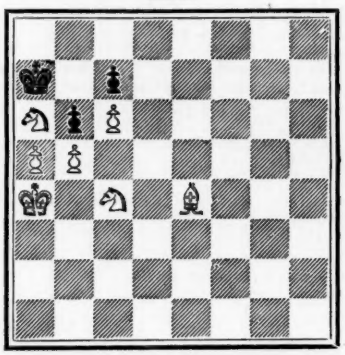
(*o*) Merely to prolong the game.

(*p*) White threatens B to K2 (ch) and R to R5 mate.

PROBLEM NO. 51.

By H. A. N.

BLACK.



WHITE.

White to play and mate in three moves.

SOLUTION.

PROBLEM No. 50, by ALFRED B. PALMER, p. 189.

1. K to Kt7	1. P to B7
2. B to Bsq	2. P to Q4
3. B to B8	3. P to K3
4. B to Kt5 mate	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Alfred B. Palmer.—Problem received with thanks.

Edward Wilson will oblige by replying to M. J. Hooton.

Leonard P. Rees.—Problem received with thanks.

C. S. Bright.—Solutions of Nos. 48, 49, and 50 correct.

Correct solution of No. 50 received from John Watson, Herbert Jacobs, and Squire.

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